Introduction

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Perceived Problem
I-64 WB MM 105 - 99

✓ Speed Differential
✓ Lane Utilization
✓ Crashes
✓ Grades
Data For I – 64 WB MM 105 - 99

✓ Volume Data
✓ Speed Data
✓ Crash Density
✓ AASHTO Climbing Lane for Multi-lane Highways Criteria
Volume Data

- Volume, Class and Speed were collected at Mile Markers 105.5, 104, 102, and 100.2
- ADT
  - 18,700 vehicles, 14% Trucks
- PM Peak Period
  - Between 5 PM and 6 PM
  - 1,840 vehicles, 9% Trucks
  - At Mile Marker 104
    - 73% (1,350) of vehicles are using the inside/left lane
Speed Data

✓ Posted Speed Limit: 65 mph
✓ 85<sup>th</sup> percentile speed: +71mph at each location for the entire day
✓ The overall travel speeds decrease as vehicles travel uphill from Mile Marker 105.5 to 100.2
  ○ Mile Marker 105.5, 77% of vehicles were traveling above the posted speed limit of 65 mph
  ○ Mile Marker 100.2, 44% of vehicles are travel at or above the posted speed limit of 65 mph
  ○ Mile Marker 100.2, 21% of vehicles traveling in the right/outer lane are traveling at speeds lower then 50 mph
Speed Comparison

I-64 Speeds at Mile Marker 105.5

<table>
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<tr>
<th>Speed Range</th>
<th>Total PM Peak Volume</th>
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<tr>
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<td>15-20</td>
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<td>322</td>
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<tr>
<td>65-70</td>
<td>702</td>
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</table>

- Inside Lane: 1
- Outside Lane: 0

I-64 Speeds at Mile Marker 100.2

<table>
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<th>Speed Range</th>
<th>Total PM Peak Volume</th>
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<tbody>
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<td>65-70</td>
<td>124</td>
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<tr>
<td>&gt;70</td>
<td>207</td>
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</table>

- Inside Lane: 1
- Outside Lane: 1
Data 105 - 99

Crash Density
Critical Length of Grade

- Mile Marker 104.8 to 104 (4,224 ft) Upgrade of 2.5%
- Mile Marker 104 to 102.5 (7,920 ft) Upgrade of 4.8%
- Mile Marker 102.5 to 99 (18,480 ft) Upgrade of 3.8%
Data I - 64 EB MM 114 - 118

✓ Crash Density
✓ Critical Grades
Data 114-118

Crash Density
Critical Length of Grade

- Mile Marker 114.5 to 115.5 (5,400 ft) Upgrade of 4.5%
5-Year Crash Analysis

- Primary Study Segment:
  - I-64 WB - MM 104 - 99

- Comparison Locations:
  - I-64 EB - MM 113 - 119
  - I-64 EB - MM 94 - 99
  - I-77 NB - MM 1 - 8
Results

- I-64 WB - MM 104 - 99
  - 76 total crashes from 2010 - 2014
    - 52.05 crashes per 100 Million VMT
      - +2.64% from Culpeper District Average
      - +20.28% from Staunton District Average
  - About 41% Rear-End crashes
Rear-End Crash Comparisons

- Study Segment: I-64 WB from MM 104 - 99
  - 31 Rear-End Collisions (Most recent - 5 years)
    - 21.22 per 100 Million VMT

- I-64 EB from MM 113 - 119
  - 51 Rear-End Collisions (Most recent - 5 years)
    - 22.70 per 100 Million VMT
Contrasting Situation

- I-64 EB from MM 94 - 99
  - 10 Rear-End Collisions (Most recent - 5 years)
    - 6.08 per 100 Million VMT
      - 3.5x lower than Study Segment

- I-77 NB 3-lane Section (Truck Climbing Lane)
  - 27 Rear-End Collisions (Most recent - 5 years)
    - 11.73 per 100 Million VMT
      - About half of Study Segment
Survey

- A survey was sent to different areas in the mid-Atlantic region for the implementation of hard shoulder running for truck climbing lane.
  - Respondents were: Two districts in western Maryland, North Carolina Department of Transportation and two districts in Western Pennsylvania
  - AASHTO criteria evaluated as part of this study is what these states use as well and no other measures were recommended or provided
  - No states surveyed had studied the use of hard shoulder running for truck climbing lanes
AASHTO Climbing Lane for Multi-Lane Highways

- If one of the following principles is satisfied, consideration of truck climbing is warranted:
  - **Critical Length of Grade**: Length of grade exceeds the critical length of grade. **Segment meets criteria**
  - **Service Flow Volume**: Service flow volume is greater than 1,000 vehicles per hour per lane (vphpl) but less than 1,700 vphpl. **Segment meets criteria**
  - **Operational Assessment-Level of Service**: Existing level of service exceeds LOS D and would be improved one grade level with the addition of a truck climbing lane. **Segment does not meet criteria**
Service Flow Volume

- Climbing lanes are generally not warranted on four lane highways with volumes below 1,000 vplph regardless of the percentage of trucks.
- When the service volumes including trucks reach 1,700 vplph, the capacity of the segment is approached and an increase in the number of lanes throughout the segment would represent a better investment than a truck climbing lane.
- PM Peak: 1,840 vehicles utilizing two lanes.
- Lane Utilization: Found that far more vehicles were using the inside/left lane.
  - At Mile Marker 104 - 1,350 of the 1,850 vehicles were using the inside/left lane.
  - Falling between 1,000 vplph and 1,700 vplph consideration of a truck climbing lane is warranted.
Operational Assessment

- The Highway Capacity methodology provides different options for analyzing uphill terrain:
  - The most conservative of “worse case” approach was to use the highest grade within the study area
    - Upgrade of 4.8% between 104 and 102.5
    - LOS B and Density of 16.5 vehicles/mile/lane
  - Using the terrain type of mountainous
    - LOS B and Density of 16.5 vehicles/mile/lane
  - Composite Grade approach
    - LOS B and Density of 15.8 vehicles/mile/lane
Potential Solutions

- Temporary Solution - FHWA Hard Shoulder Running
- Project Conceptualization
- Prior to use of shoulder or breakdown lanes, the DOT has to seek approval from FHWA to implement the strategy as a temporary measure until funding and approval are obtained for widening
- The intent is for these facilities to be temporary in nature and not a permanent fixture for long-term capacity provision
Temporary Solutions

- Temporary Use of Shoulder for Truck Climbing
- Use of shoulder for General Purpose traffic with trucks using existing left lane
Potential Temporary Solution

I-64 Existing Westbound Lanes
Proposed cross-section for milepost 105 to milepost 99

I-64 Proposed Westbound Lanes
Proposed cross-section for milepost 105 to milepost 99
Potential Permanent Solution

- Add a lane into the median with the addition of barrier wall
  - This strategy is reversible for critical grades in EB and WB direction
Benefit from Crash Reduction

- HSIP Methodology
  - Assumed 50% crash reduction based on I-77 comparison and percentage of existing Rear-End/Low Speed Collisions

- Temporary Solution (10 Year Service Life)
  - $1.48 Million Present Value of Benefit

- Permanent Solution (20 Year Service Life)
  - $2.58 Million Present Value of Benefit
Next Steps

✓ Develop Typical Section
  o Temporary
  o Permanent

✓ Identify Elements Needed

✓ Estimate Costs
  o Resurface and restripe
  o Widen to the median
  o Add median barrier